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Table 1-1. Commercial Glass Compositions in Oxides Per Cent by Weight

Vitreous silica	Vycor	Plate	Window	Bottle or container	Bulb	Tubing	Lime tableware	Pyrex type	Thermometer	Borosilicate crown	Lead tableware	Glass halogen lamp	Eglass	S glass	Optical flint
100.0	94.0	72.7	72.0	74.0	73.6	72.1	74.0	81.0	72.9	69.6	67.0	60.0	52.9	65.0	49.8
		0.5	0.6	1.0	1.0	1.6	0.5	2.0	6.2		0.4	14.3	14.5	25.0	0.1
	5.0							12.0	10.4	9.9			9.2		
		0.5	0.7	Tr.								0.3			
		13.0	10.0	5.4	5.2	5.6	7.5		0.4			6.5	17.4		
			2.5	3.7	3.6	3.4			0.2				4.4	10.0	
				Tr.						2.5		18.3			13.4
											17.0				18.7
	1.0	13.2	14.2	15.3	16.0	16.3	18.0	4.5	9.8	8.4	6.0	0.01			1.2
				0.6	0.6	1.0			0.1	8.4	9.6	Tr.	1.0		8.2
															8.0
		Tr.	Tr.	Tr.	Tr.		Tr.		Tr.	0.3	Tr.				0.4

Table 3-3. Field Strengths of Various Ions^a

Element	Valence Z	Ionic radius (for CN = 6) r in Å	Most frequent coordination number CN	Ionic distance for oxides a in Å	Field strength at distance of O ²⁻ ions Z/a ²	Function in glass structure
Li	1	1.33	8	2.77	0.13	Network modifier Z/a ² ≈ 0.1 ... 0.4
Na	1	0.98	6	2.30	0.19	
K	1	0.78	6	2.10	0.23	
Rb	2	1.43	8	2.86	0.24	
Ag	2	1.32	8	2.74	0.27	
Cs	2	1.27	8	2.69	0.28	
Ca	2	1.06	8	2.48	0.33	
Sc	2	0.91	6	2.23	0.40	
Y	2	0.83	6	2.15	0.43	Intermediate Z/a ² ≈ 0.5 ... 1.0
Mg	2	0.83	4	2.03	0.49	
Zn	2	0.78	6	2.10	0.45	
B	3	0.87	4	1.96	0.53	
Al	3	0.87	8	2.28	0.77	
Fe	3	0.34	4	1.53	0.86	
Cr	3	0.67	6	1.99	0.76	
Th	4	0.67	4	1.88	0.85	
U	4	0.57	6	1.89	0.84	Network former Z/a ² ≈ 1.5 ... 2.0
Pa	4	0.57	4	1.77	0.96	
La	3	0.64	6	1.96	1.04	
Pr	3	0.20	4	1.50	1.34	
Sm	3	0.44	4	1.66	1.45	
Eu	3	0.39	4	1.60	1.57	
Gd	3	0.34	4	1.55	2.1	
Lu	3	0.20	3	1.36	1.63	

where Z is the valency of the cation, and r_c and $r_{O^{2-}}$ are the ionic radii of the cation and the oxygen ion in Å units. If e is the electronic charge, then F is the force exerted by the cation on a unit point charge placed at the position of the oxygen ion. Values of the field strength for the various ions are given in Table 3-3.

According to Table 3-3 [11], the network-forming cations have high field strengths (1.5 to 2.0), the network-modifying cations have low field strengths (0.1 to 0.4), and those having F values, between 0.5 and 1.1 are the intermediate cations. Apparently, the high-field-strength cations repel each other strongly. At the same time, their small size requires low-coordination-number cations with the oxygen. The two factors promote disordered arrange-